

NO ν A R&D request to Fermilab for FY05

- Sent to the (new) Particle Physics Division Head, Jim Strait
 - Budget presentation is early November
 - Continuing Resolution likely anyway, limits funds
- FYI, we spent about \$ 75 K in FY04
- Copies of FY05 spreadsheet available

NOvA FY05 R&D Request

All FY05 effort is aimed at an improved proposal for late spring 2005.

Items A and B were called out by the PAC

The signal size is a crucial parameter and heavily dominates the detector size and cost

The Cosmic Ray Background rate for a surface detector needs understanding and dominates the building cost

Item C is necessary to prove that the Totally Active version (preferred) of the detector can be constructed

Item D is aimed at further improvements in the cost estimate

Item E is just a WAG to illustrate future R&D needs assuming approval in 2005

513

(K\$) is the total request for FY05

The likely allocation will be about \$ 300 K

3.53

FTEs is the request for Fermilab effort in FY05, details below on effort type

1,680

(K\$) is the total need identified so far for R&D in FY05, 06

A. Verifying the signal size for Liquid Scintillator / fiber / APD chain

FY05

Total

Request K\$

Need K\$

Item

278

765

Subtotal A

B. Cosmic Ray Background Test

74

84

Subtotal B

C. Structural Analysis of the Totally Active Detector

71

114

Subtotal C

D. Site & Building Work

22

32

Subtotal D

E. Design & Prototyping of final technology choice

68

685

Subtotal E

A. Verifying the signal size for Liquid Scintillator / fiber / APD chain					
FY05	Total			FY05	
Request K\$	Need K\$	Item		Fermilab FTEs	type
		Extrusion Prototypes			
-	38	a. Second pass with another vendor on the baseline cells, 3 cells by 48' long (our first "low bid" vendor using FY04 \$ is having some trouble producing a usable product, hope 4th iteration is OK)			
45	45	b. Another pass with another (?) vendor on the Totally Active cells, 3 cells by 48' long			
-	250	c. 32-cell wide version for final technology choice (\$ 65 K die + cost / ft of prototype parts)			
5	5	Liquid Scintillator purchase 3x 55 gal from ELJEN, have some additional at Minnesota and CalTech			
10	10	Liquid Scintillator R&D , check light output of various concentrations of psuedocumene and waveshifters			
		Indiana(5) and CalTech(5) work, these components are cost drivers for the liquid			
3	3	Fiber purchase , have some on hand but will order more. This is 2 km of 0.8 mm diameter S-type.			
15	15	Bubble effects / Fiber position studies , tech and eng time at universities / labs			
		Machining and assembly for light output tests			
		two manifold types, bottom seal, top opening + fiber routing box			
20	20	need hand-crafted prototypes for light output work, tech time		likely?	
		Light output: reflectivity and some lifetime studies			
20	20	understand TiO2 level, study effects of temperature, oxygen, ... machining and tech assembly at universities			
		APD work with Hamamatsu			
100	100	a. NRE design, low cost bare die. Product is a design report. This is the first step in a better understanding of the APD costs.			
		They design a pixel size to match our fibers, develop a method to mount APDs using flip-chip techniques			
-	150	b. This second step creates a new APD mask set, qualifies the flip-chip scheme, engineers the cooler on the back side of the APD and produces about 5 prototype parts for our evaluation			
33	54	ASIC for flip-chip assembly with APD , Yarema group design, then \$ for submission		0.50	1 engineer for 6 mo.
		\$ 54 K would get 300 chips, \$ 33 K gets only 40 chips, in design now, submission is Jan 05, testing in April 05			
		Board level items (initial work done in FY04, this would be a 2nd pass)			
10	20	Eng & tech support at universities			
5	10	prototype boards			
		APD Housing - design prototype , initial test will be done with FY04 purchase kludge items			
10	20	Eng and tech support at universities			
2	5	Materials			
278	765	Subtotal A			

B. Cosmic Ray Background Test						
FY05	Total					
Request K\$	Need K\$	Item			Fermilab FTEs	# / type
		Rework MINOS scintillator modules for NOvA test (we have MINOS approval)				
10	10	a.	cut 18 modules at Soudan, transport to surface and ship to Fermilab			
			also ship the strongback parts back to Fermilab, needed to take apart the 4 plane prototype in NMS			
-	-	b.	assemble strongback and remove 26 modules in NMS MINOS 4 plane prototype			0.38 4 techs for 5 weeks
-	-	c.	cut 26 NMS modules			0.04 2 techs for 1 week
-	-	d.	fly cut ends of 44 modules in PPD Technical Centers			0.04 1 tech for 2 weeks
		Construct the Background Test in Lab E (or possibly in New Muon)				
22	22		purchase particle board			
2	2		other miscellaneous parts (drywall screws, glue, supports for active veto counters)			
-	-		assemble particle board absorber			0.19 2 techs for 5 weeks
-	-		assemble MINOS modules on particle board sub-assemblies			0.38 2 techs for 10 weeks
-	-		stack sub-assemblies inside shield block book-ends			0.15 4 techs for 2 weeks
-	-		cabling, optical and electronics			0.38 2 techs for 10 weeks
-	-		active veto installation			0.08 2 techs for 4 weeks?
40	50	Purchase additional MINOS style electronics for items with slim spare counts in MINOS				
			likely will need PMTs for Active shield scintillator modules surrounding the test calorimeter			
			may have to leave some items for FY06			
74	84		Subtotal B			

C. Structural Analysis of the Totally Active Detector						
FY05	Total					
Request K\$	Need K\$	Item			Fermilab FTEs	# / type
		"Half-size" prototype at ANL (2.5 cm x 3.5 cm cells, 28' high by 15' wide plane, several layers)				
			4 layers material done on ANL funds in FY04, they cannot continue effort with internal funding			
			The idea is to test assembly techniques, gluing together commercially available extrusions, not custom ones			
			Intend to have crude prototype end seals on this, fill with water and overpressure for structural studies			
12	12	a.	Material for 2nd prototype anticipated in FY05 based on experience with 1st, likely more layers			
20	32	b.	ANL engineering effort, about 2 months worth			
30	52	c.	ANL technician effort, about 5 months worth			
9	18	General cell and material tests (0.5 mo eng + 1 mo tech ANL), coordinate with effort at Fermilab			0.08	1 mo. engineer
			this would use the custom extrusions where possible			0.04
			e.g. creep tests, other material tests with different levels of TiO2			1 tech for 2 weeks
-	-	finite element analysis to match half-size prototype, also scale up to full-size device			0.50	1 engineer, 6 mo.
71	114		Subtotal C			

D. Site & Building Work					
FY05	Total				
Request K\$	Need K\$	Item		Fermilab FTEs	# / type
12	12	Hire an engineering firm to:			
		a. help Marshak with a field inspection @ Ash River, select 2-3 possible sites. Summer 05 or wait a full year due to weather.			
		b. lay out a plan to obtain environmental permits necessary for construction			
		c. provide budgetary estimates for roads / utilities at each site			
-	-	Get the University of Minnesota real estate people to pursue acquisition of either title or options for these sites			
10	20	FESS to do design and cost of "final" building			
		With overburden / no overburden result from the Cosmic Ray Background Test, take next design step to reduce cost uncertainty			
		Current cost estimate has a 75% contingency on this item.			
22	32	Subtotal D			

E. Design & Prototyping of final technology choice					
FY05	Total				
Request K\$	Need K\$	Item		Fermilab FTEs	# / type
		Module Design, manifold prototypes and seals for 32 cell extrusion			
		Manifolds and Seals, may guide design of final technology choice 32 cell extrusion prototype		?	
5	10		materials		
10	20		Engineering support (U of Minn eng students)		
10	48		Module design at ANL		
10	20		Tech assembly and testing at U of Minn		
10	21		Tech time at ANL		
		Assembly process engineering			
8	16		at ANL		
15	30		at U of Minn.		
-	-		at Fermilab	0.50	6 mo. engineer
				0.25	3 mo. Designer
		Full scale prototype (this part is a WAG)			
-	120		material for an estimated 5 layers, then 10x the "half size" 4 layer construct currenty underway at ANL		
-	50		construct prototype plane mover	?	
-	50		tech time to assemble	?	
-	50		fiber		
-	200		APDs		
-	50		more ASICs		
-	-		other electronics?		
68	685		Subtotal E		